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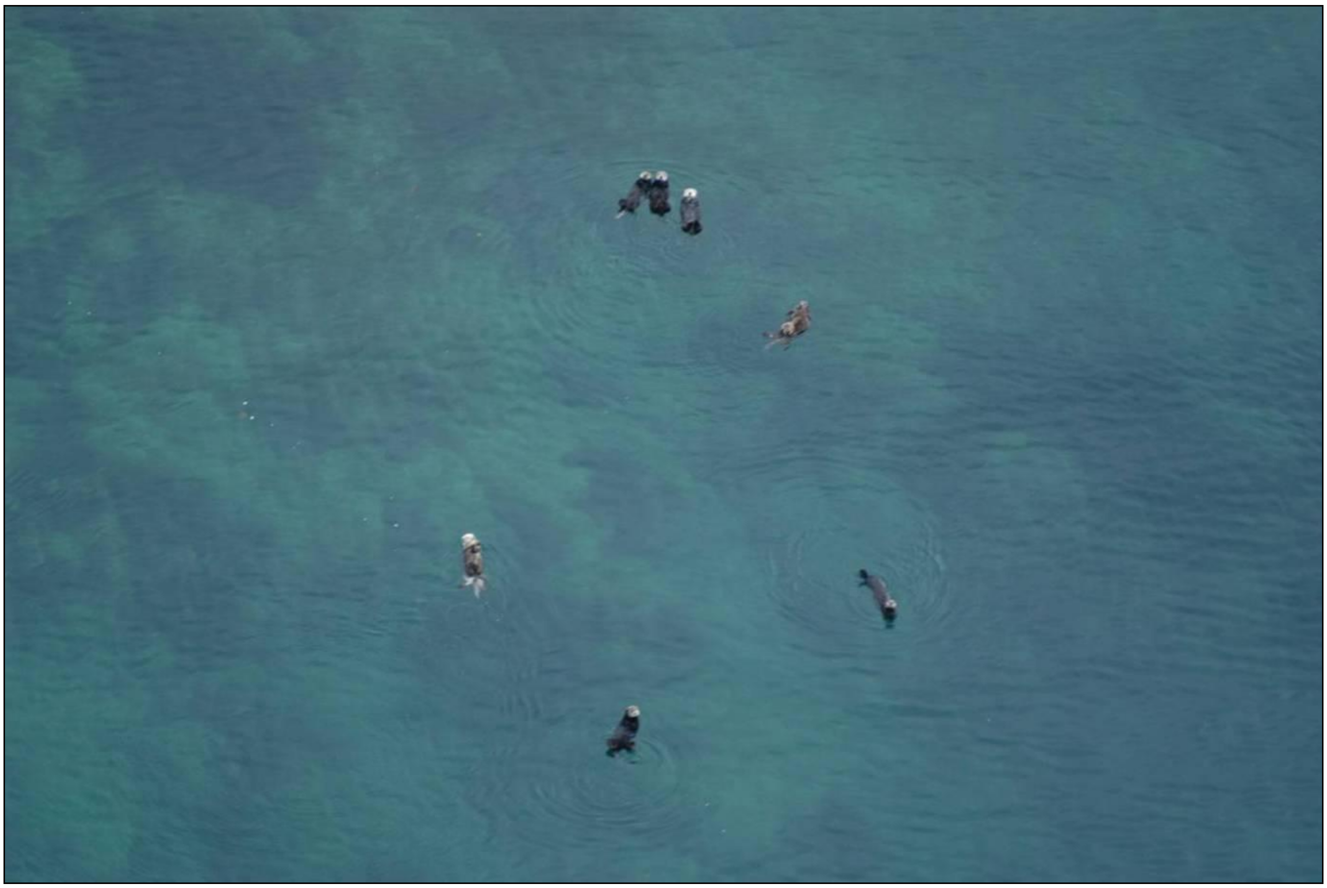
Southwest Alaska Network Inventory and Monitoring Program

Natural Resource Technical Report NPS/SWAN/NRTR—2010/417



ON THE COVER
Aerial view of a group of sea otters
Photograph by: James L. Bodkin, USGS

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January 2011

U.S. Department of the Interior
National Park Service
Natural Resource Program Center
Fort Collins, Colorado

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Please cite this publication as:

Coletti, H. A., J. L. Bodkin, and G. G. Esslinger. 2011. Sea otter abundance in Kenai Fjords national Park: results from the 2010 aerial survey: Southwest Alaska Inventory and Monitoring. Natural Resource Technical Report NPS/SWAN/NRTR—2011/417. National Park Service, Fort Collins, Colorado.

NPS 186/106422, January 2011

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Abstract

A sea otter aerial survey was completed in Kenai Fjords National Park (KEFJ) during June of 2010. This was the third aerial survey completed since 2002 along the Kenai Peninsula, the second specifically conducted within KEFJ. Survey methodology followed the Bodkin and Udevitz (1999) method which accounts for imperfect detection. The survey took two days to complete. The estimated sea otter population for KEFJ is 1322 individuals, with an overall density of 0.89/km^2. The 2010 population estimate is similar to that of 2007 (1511 individuals, 1.02/km^2). Sea otters were not uniformly distributed along the coastline. Higher concentrations of sea otters were found near Sandy Bay, James Lagoon, along the moraine crossing McCarty Fjord, Nuka Bay and Nuka Island. All observed otters were in the high density stratum, defined as the 0 m to 40 m depth contour and minimum distances from shore, while no sea otters were observed in the low density stratum, which is defined as the area within the 40m to 100 m depth contour. We recommend that prior to the next aerial sea otter survey in KEFJ (scheduled for 2013), a power simulation be conducted to evaluate methods to improve precision of estimates and the ability to detect change.

Acknowledgments

The National Park Service, SWAN, KEFJ and the USGS Alaska Science Center supported this work. We would like to thank Pat Kearney for his piloting expertise. We would like to recognize Doug Burn, USFWS Marine Mammals Management, for his exceptional contribution in the development of an ArcPad sea otter aerial survey application and a SAS program that has greatly streamlined the data collection and analysis process. We would also like to thank Mark Kansteiner of Kenai Fjords National Park for his logistical support. Thank you to Doug Burn, Mark Udevitz, Brian Hatfield and Laura Phillips for their thoughtful reviews.

Introduction

Sea otters (*Enhydra lutris*) are a common, conspicuous, and important component of the nearshore food web throughout most of the North Pacific. They occupy all types of nearshore habitats from sheltered bays, estuaries, and fjords to exposed rocky coastlines (Kenyon 1969), but are constrained by their diving ability to habitats shallower than 100 m depth (Bodkin et al. 2004) and a near exclusive dietary reliance on benthic invertebrate prey (Riedman and Estes 1990). As a consequence of their nearshore distribution and relatively small home ranges, a rich literature exists on the biology, behavior, and ecology of the species. The sea otter provides one of the best documented examples of top-down forcing effects on the structure and function of nearshore marine ecosystems in the North Pacific Ocean (Kenyon 1969, VanBlaricom and Estes 1988, Riedman and Estes 1990, Estes and Duggins 1995) and are widely regarded as a "keystone" species in coastal marine ecosystems (Power et al. 1996). They cause well described top-down cascading effects on community structure by altering abundance of prey (e.g. sea urchins) which can in turn alter abundance of lower trophic levels (e.g. kelps). Sea otters generally have smaller home ranges than other marine mammals; eat large amounts of food; are susceptible to contaminants such as those related to oil spills; and have broad appeal to the public. Recent declines in sea otters have been observed in the Aleutian Islands. As a result, the southwest Alaska stock of sea otters, which occurs from Cook Inlet to the Western Aleutian Islands and includes Katmai National Park and Preserve as well as Aniakchak National Monument and Preserve, was federally listed in September 2005 as threatened.

For the reasons outlined above, several metrics related to sea otters are incorporated under the sea otter vital sign of the National Park Service Southwest Alaska Network (SWAN) Vital Signs Inventory and Monitoring Program (http://science.nature.nps.gov/im/units/swan/). They include: (1) sea otter aerial surveys to estimate population abundance, (2) sea otter carcass collections to evaluate the age structure of the dying population, and (3) observations of sea otter foraging. Because sea otters occur outside the boundaries of the skiff-based shoreline marine bird and mammal surveys, and because detection is not estimated during the skiff-based surveys, aerial surveys designed specifically to provide accurate and precise estimates of sea otter abundance (Bodkin and Udevitz 1999) are incorporated into the nearshore monitoring program. The methods and results of the 2010 sea otter aerial survey in Kenai Fjords National Park (KEFJ) are reported here.

Methods

The survey follows protocols described in detail in Bodkin and Udevitz (1999). These protocols are summarized here. The survey is conducted from a small, single engine, float equipped aircraft with the pilot and observer able to observe out each side of the aircraft. The airplane is flown at a speed of 105 kph (65 mph) and at an elevation of 91 m (300 ft). The survey design consists of systematic sample of 400 m wide transects spanning the survey area. Sampling intensity is proportional to expected sea otter abundance with most survey effort taking place where higher densities of sea otters are generally observed. The high density sea otter stratum extends from shore to 400 m seaward or to the 40 m depth contour, whichever is greater. Bays and inlets less than 6 km wide are also categorized as high density strata, regardless of depth. The remaining survey effort is over deeper, offshore waters where lower densities are generally observed (Figure 1). Specifically, the low density sea otter stratum extends from the high density stratum line to 2 km offshore or from the 40 m depth contour to the 100 m depth contour, whichever is greater. Intensive searches, initiated by the observer, are periodically conducted within the transect swaths to estimate the proportion of sea otters not detected. Strip counts are adjusted for the area not surveyed and by a detection correction factor to obtain an adjusted population size estimate. Additionally, groups larger than approximately 20 individuals are circled until a complete count is obtained and are treated as a separate stratum, uncorrected in the analysis.

Survey transects used in 2010 were identical to those used in 2002 and 2007 with spacing of transects in the shallow water strata or high density strata every 3 km and 12 km between transects in the deep water strata or low density strata. One methodological difference between this survey and prior surveys in KEFJ was the way data was recorded. In the past, data was entered using pencil and paper during the survey and re-entered into a computer after the survey. This year, survey data was entered directly into a tablet style computer (Panasonic Toughbook) using an ArcPad (ESRI, Redlands, CA) application specifically designed for sea otter aerial surveys. The main advantage of this method was that otter group locations were digitized more accurately while on the transect.

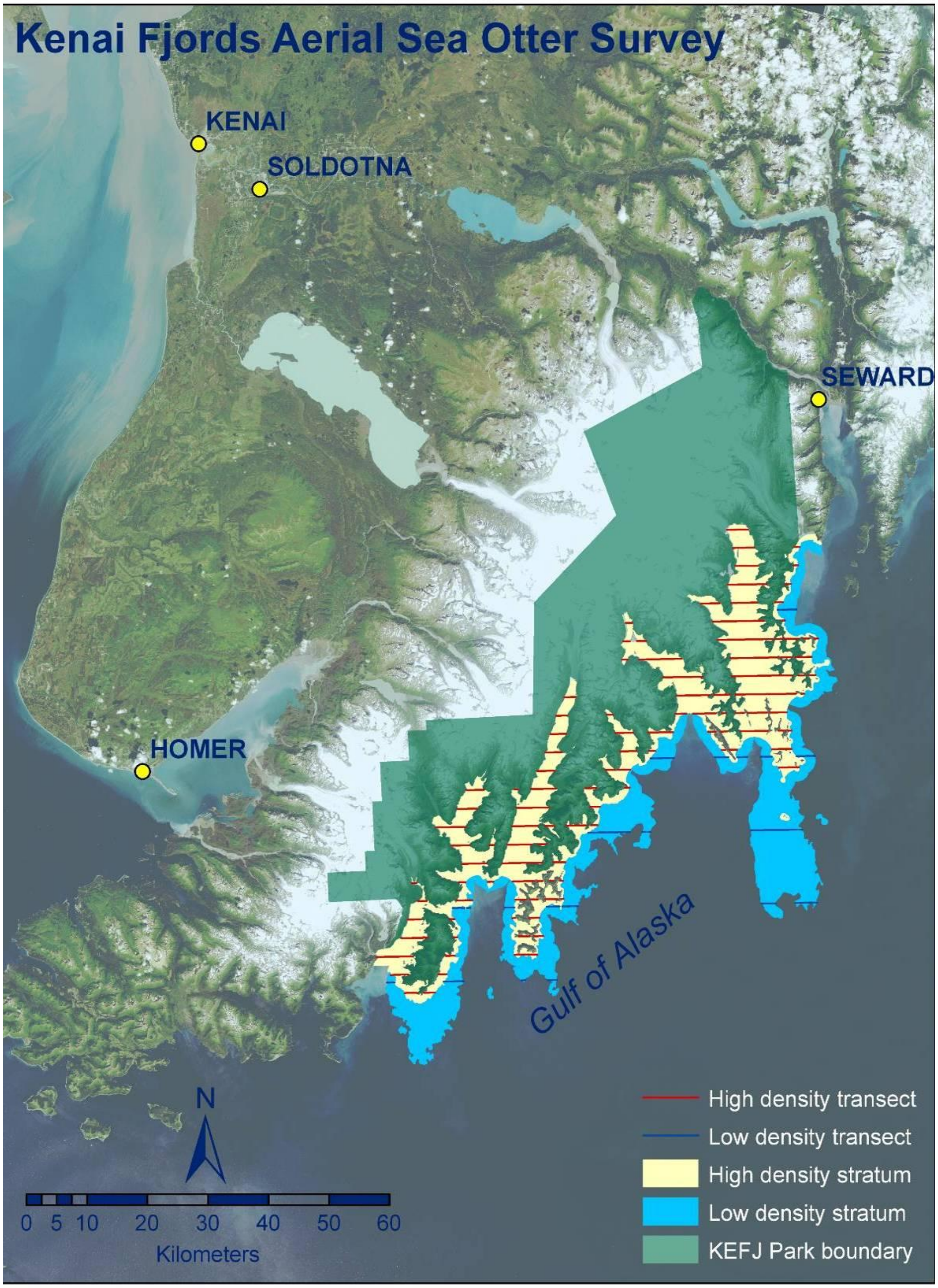

Figure 1. Sampling transect locations for the high density stratum (in yellow) and low density stratum (in blue) used in the aerial survey of sea otter abundance in KEFJ during June of 2010.

Results

Between 25 and 26 June, 2010, 122 transects (319 linear km) in the high and low density strata were surveyed in KEFJ to estimate sea otter abundance (Table 1). The high density stratum consisted of approximately 832 km^2 and the low density of approximately 654 km^2, representing 319 linear km in the shallow water and deep water strata (Figure 1). One hundred and six transects comprising 280 km of high density transect length, and 16 transects comprising 39 km of low density transect were surveyed. Sea otters were only observed on high density transects (Table 1, Figure 2). Pups were also observed throughout the high density stratum (Figure 2). The estimated detection probability was 0.55 resulting in a correction factor of 1.81 and a total estimated population size of approximately1322 sea otters residing in KEFJ resulting in an overall density of 0.89/km^2 (Table 1). Four large groups (>10) of sea otters were observed off transect. Two of these groups were in the vicinity of Otter Cove, one near Sandy Bay and the fourth large off-transect group was in McCarty Lagoon (Figure 3).

Table 1. Sea otter population abundance estimates for KEFJ from 2010. Uncorrected population size is the population size before the correction factor is applied to calculate adjusted population size.

Stratum	Uncorrected Population Size	Correction Factor	Adjusted Population Size	*SE*	Density #/km2
High Density	639	1.81	1158	470	1.39
Low Density	0	.	.	.	0.00
Total			**1322**[1]	**494**	**0.89**

[1] Total adjusted population size does not equal the sum of the high and low density strata because the adjusted population size also includes complete counts. Complete counts are treated as a separate stratum in the analysis.

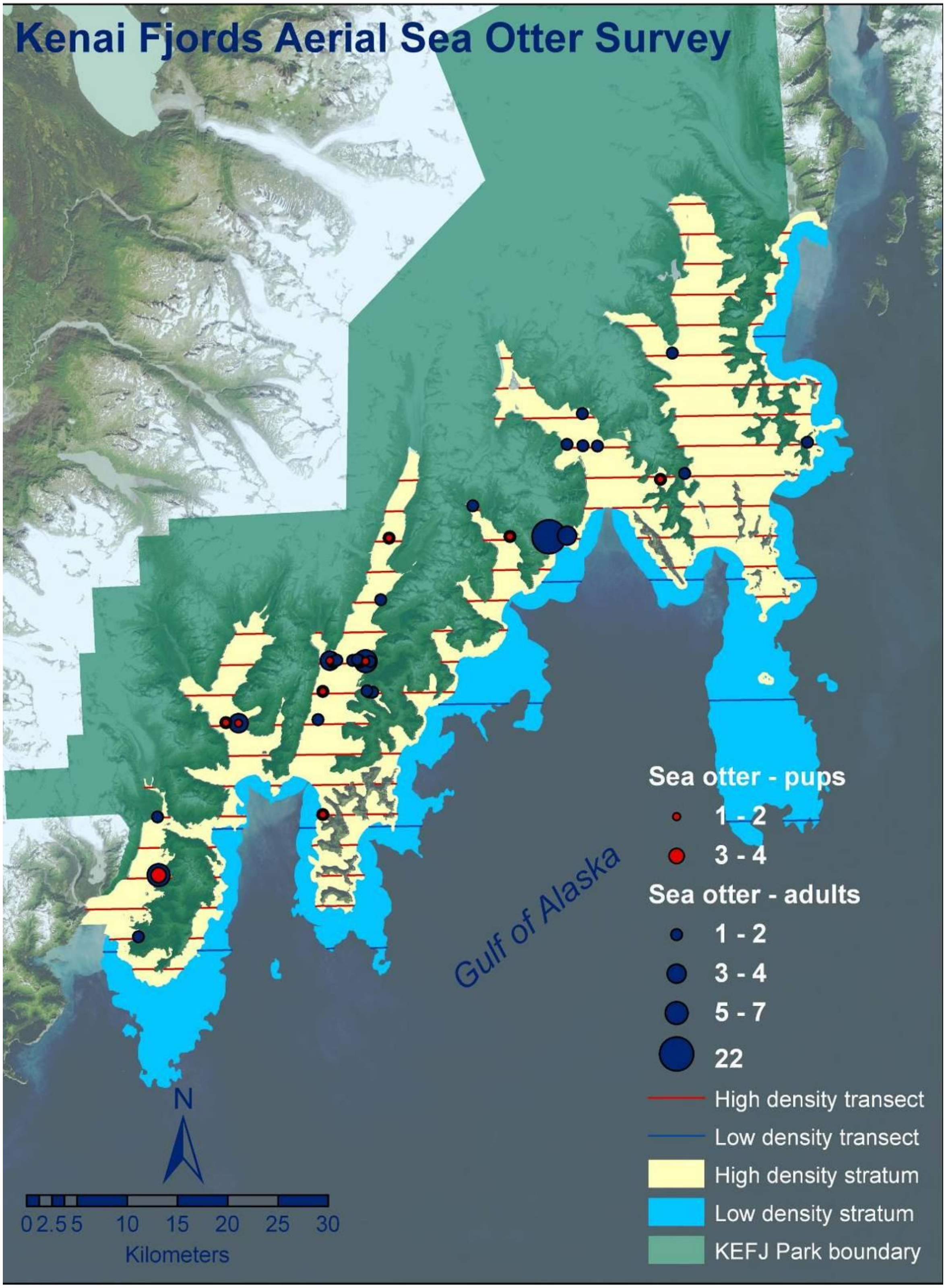

Figure 2. Distribution and relative abundance of adult and pup sea otters in KEFJ, June 2010.

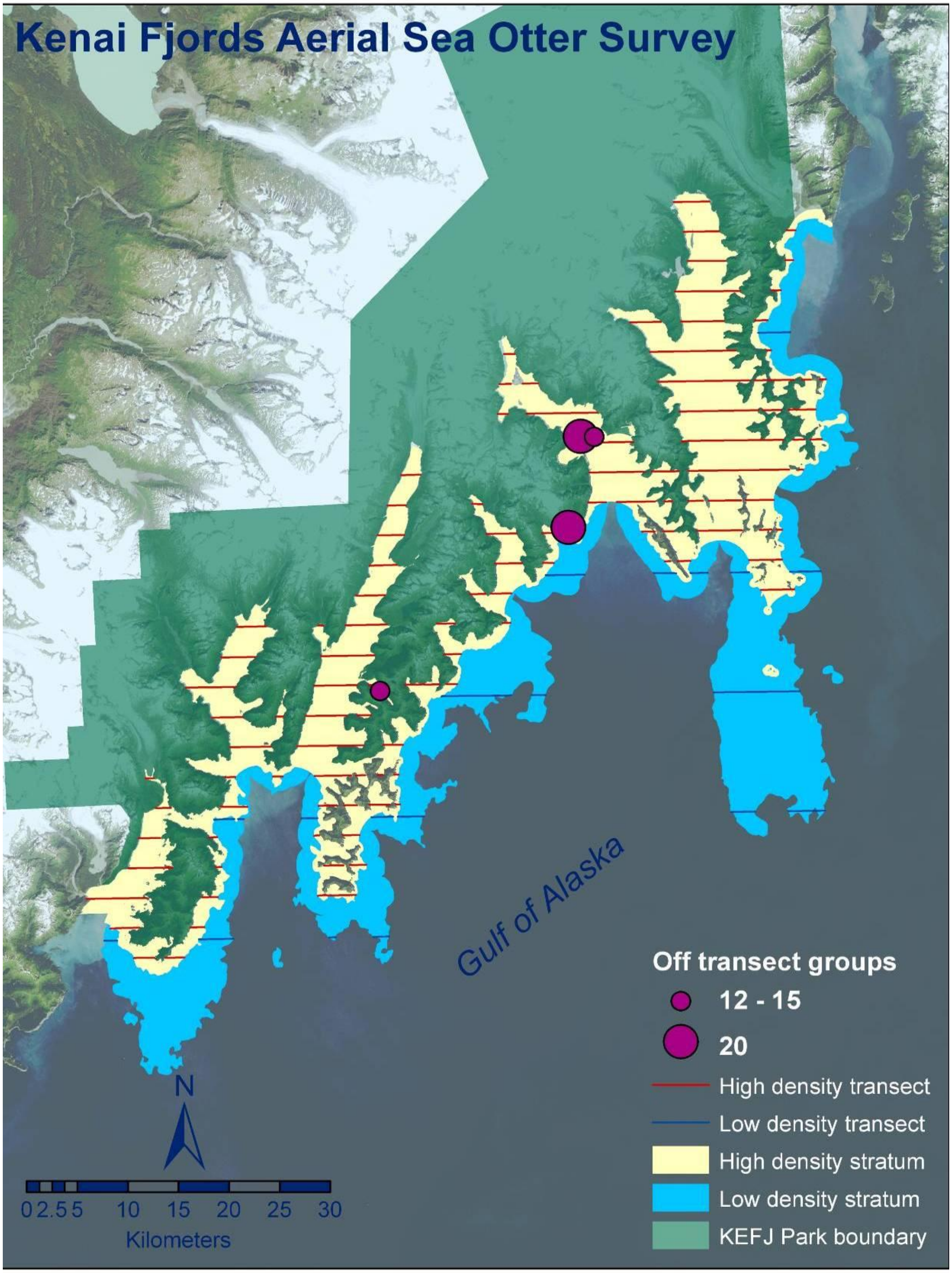

Figure 3. Large groups (>10) of sea otters observed off transect, KEFJ 2010

Discussion

Between 2002 and 2010 we have conducted 3 surveys of sea otter abundance in KEFJ Abundance estimates range from 799 in 2002 to 1511 in 2007 and 1321 in 2010 (Table 2). The mean density of sea otters over both high density and low density strata for the three surveys is 0.82/km^{2}, and during two of the three surveys no sea otters were observed on low density stratum transects. Densities of sea otters in KEFJ are slightly less than in neighboring western Prince William Sound where densities range from 0.88 in 2002 to 1.89/km^2 in 2009 (USGS unpublished data).

Proportional standard errors of abundance estimates in KEFJ average 0.41 and are relatively high for this type of survey. In nearby Prince William Sound proportional standard errors of annual surveys are typically between 0.10-0.20 (USGS unpublished data). We have no cause to suspect that our estimates of sea otter abundance in KEFJ are not accurate, but the high error terms may require a longer time series of data to detect significant trends than desired for management purposes.

Contrary to the results of the classification of high density sea otter habitat in KEFJ (Figure 1) for the aerial survey, sea otter habitat is fairly limited in KEFJ. The high density sea otter stratum extends from shore to 400 m seaward or to the 40 m depth contour, whichever is greater. Bays and inlets less than 6 km wide are also categorized as high density strata, regardless of depth. In the case of KEFJ, the classification of habitat into the high density stratum is primarily due to the minimal width of bays and inlets, not because of the abundance of shallow (< 40 m in depth) waters. This is primarily a consequence of the steep nature of the benthic terrain in nearshore waters which limits the area of shallow water (< 40 m in depth) that is preferred sea otter foraging habitat.

Because sea otter habitat is limited, sea otter abundance is generally low and because the Park is comparatively small, relatively few groups of sea otters are present and available to be encountered on transects surveyed. As a result of the small number of groups of sea otters encountered and the low number of intensive searches suitable for estimating detection, the proportional standard error terms associated with each abundance estimate are relatively high, ranging from 0.37 to 0.44. This should not be construed to mean that the abundance estimates are not accurate, but rather that they are relatively imprecise. There are at least two possible means to reduce the magnitude of the error terms associated with the abundance estimates. One would be to increase the intensity of transects to a maximum of one per 1200 m from the present one per 3 km. This should result in a proportional increase in the number of groups detected, and a corresponding reduction in the error term. Another approach would be to conduct multiple replicate surveys over a short time window that would provide a more precise estimate of abundance.

In order to evaluate the ability to detect meaningful change in sea otter abundance in KEFJ we recommend that prior to the next aerial sea otter survey in KEFJ, a power simulation to evaluate the ability to detect trends over time be conducted. We further suggest the use of the 3 years of data from KEFJ to initiate the analysis. Additional data from nearby Prince William Sound, Katmai National Park and Preserve and Glacier Bay National Park and Preserve, where similar survey data exist, may be incorporated in this analysis for comparison and to develop recommendations on the need and methods to improve precision of estimates and the ability to detect change.

Table 2. Sea otter population abundance estimates for KEFJ from 2010, 2007 and 2002. Uncorrected population size is the population size before the correction factor is applied to calculate adjusted population size.

Year	Stratum	Uncorrected Population Size	Correction Factor	Adjusted Population Size	*SE*	Density #/km2
2010	High Density	639	1.81	1158	470	1.39
	Low Density	0	.	.	.	0
	Total			**1322**[1]	**494**	**0.89**
2007	High Density	706	1.84	1298	603	1.56
	Low Density	116	1.84	213	165	0.33
	Total			**1511**	**625**	**1.02**
2002	High Density	476	1.68	799	349	0.96
	Low Density	0	1.68	0	.	0
	Total			**799**[2]	**349**	**0.54**

[1] Total adjusted population size does not equal the sum of the high and low density strata in 2010 because the adjusted population size also includes complete counts. Complete counts are treated as a separate stratum in the analysis.

[2] Total adjusted population size is equal to the sum of high and low density strata in 2002 because there were no large groups observed to warrant complete counts during the 2002 survey.

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NPS 186/106422, January 2011

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